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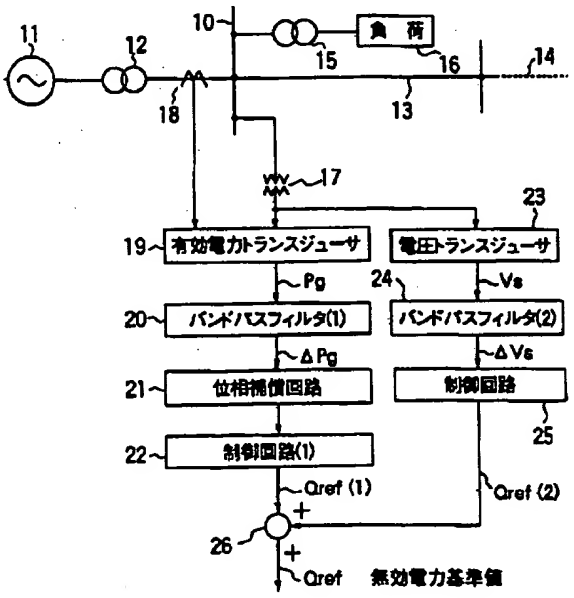
(54)【発明の名称】　超電導エネルギー貯蔵装置の制御装置

(57)【要約】

【目的】　ＳＭＥＳの特性を利用して、電力動揺の抑制と過渡的な電圧変動の抑制をなす。

【構成】　超電導エネルギー貯蔵装置が設置されている近傍の発電機11の有効電力を入力信号とし19、バンドパスフィルター20と補償回路21並びに制御回路22を通して第1の出力$Q_{ref}$ (1) を得、又、超電導エネルギー貯蔵装置が設置されている母線10の電圧を入力信号とし23、バンドパスフィルター24と制御回路25を通して第2の$Q_{ref}$ (2) を得る。そして加算器26で$Q_{ref}$ (1) と$Q_{ref}$ (2) を合成して無効電力基準値とする。



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【特許請求の範囲】

【請求項1】　超電導エネルギー貯蔵装置が設置されている近傍の発電機の有効電力を入力信号として、バンドパスフィルターと位相補償回路並びに制御回路を介して第1の出力を得ると共に、当該超電導エネルギー貯蔵装置が設置されている母線の電圧を入力信号として、バンドパスフィルターと制御回路を介して第2の出力を得、これら第1，第2の各出力を加算器で合成して得られる出力を無効電力基準値とすることを特徴とする超電導エネルギー貯蔵装置の制御装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は超電導エネルギー貯蔵装置の制御装置に関する。

【0002】

【従来の技術】超電導エネルギー貯蔵装置（SuperconductingMagnetic Energy Storage，以下説明の便宜上ＳＭＥＳと略記する）は、本来、電力系統において電力が余剰になったときにこれを吸収して磁気エネルギーとして貯えておき、電力が不足になったときに磁気エネルギーを電力に変換して電力系統に放出し、電力系統における電力の需要と供給がバランスするように制御される。しかし、ＳＭＥＳはその有効電力と無効電力の吸収・放出が変換装置により高速に制御できる能力を有しているため、単にエネルギー貯蔵に留まらず、電力系統に発生する速い負荷変動に対する負荷追従機能、即ち、周波数変動制御に対する寄与並びに電力動揺や電圧変動の抑制等の系統安定化制御に対する寄与が期待されている。電力系統に発生する速い負荷変動に対する負荷追従を目的としたＳＭＥＳの有効電力の制御装置については既に提案済みである（特願平2-59108 号）。

【0003】

【発明が解決しようとする課題】上記した従来装置によれば、ＳＭＥＳの有効電力を制御して速い負荷変動に対する負荷追従をさせるものであり、またＳＭＥＳの無効電力の制御は静止型無効電力補償装置（ＳＶＣ）と同じように、系統の電圧のみを一定に維持するものであった。本発明は上記事情に鑑みてなされたものであり、ＳＭＥＳの無効電力を制御することにより、電力動揺の抑制と過渡的な電圧変動の抑制をも可能な超電導エネルギー貯蔵装置の制御装置を提供することを目的としている。

【0004】

【課題を解決するための手段】上記目的を達成するため、本発明はＳＭＥＳ設置点の近傍の発電機の有効電力を入力信号とし、バンドパスフィルターと位相補償回路並びに制御回路を通して得られる第1の出力と、ＳＭＥＳ設置点の近傍の系統電圧を入力信号とし、バンドパスフィルターと制御回路を通して得られる第2の出力を夫々加え合わせて得られる出力信号を、ＳＭＥＳの有効・無効電力制御装置の無効電力基準値とする構成とした。

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【作用】ＳＭＥＳの無効電力が、上述した無効電力基準値に一致するように制御されれば、無効電力基準値を構成する第1の出力は電力動揺の抑制に寄与するように作用し、一方、第2の出力は過渡的な電圧変動の抑制に寄与するように作用する。

【0005】

【実施例】以下図面を参照して実施例を説明する。図1は本発明によるＳＭＥＳの制御装置を説明するための一実施例の構成図であり、特に図1はＳＭＥＳの有効・無効電力制御装置の中の無効電力基準値の作成回路を示す。なお、図2はＳＭＥＳの有効・無効電力制御装置の全体の制御ブロック図を参考として挙げている。そして図2の点線部分は既出願内容であり、本発明のものと区別するためにあえて示したものである。図2を簡単に説明する。先ず、ＳＭＥＳは変圧器Ｔを介して母線に接続されている。母線近傍からＰＱ検出器によって無効電力Ｑを検出し、指令値$Q_s$に一致するように運転され（正常運転時$Q_{r1}$は零）、演算回路による$\alpha$（位相制御角）、Ｍ（制御率）が演算され、各相ＧＴＯへ出力される。図2は本発明の要旨でないため、これ以上の説明はしない。

【0006】次に図1を説明する。図1において、10は母線で図示しないＳＭＥＳが接続される。11はＳＭＥＳ設置点の近傍の発電機で、主変圧器12と送電線路13を介して電力系統14に接続されている。15は負荷用変圧器、16は負荷、17は母線10の電圧を検出する電圧変成器、18は発電機11から母線10に流入する電流を検出する電流変成器、19は有効電力トランスジューサで、その出力（直流値）には発電機11の有効電力$P_s$が得られる。20は有効電力$P_s$の中のある周波数帯域の成分$\Delta P_s$を取り出すバンドパスフィルター(1)、21と22は夫々位相補償回路と制御回路(1)である。

【0007】一方、23は電圧トランスジューサでその出力（直流値）には母線10の電圧$V_s$が得られる。24は電圧$V_s$の中のある周波数帯域の成分$\Delta V_s$を取り出すバンドパスフィルター(2)、25は制御回路(2)である。制御回路(1) 22の出力(1)（$Q_{r1}$(1)）と制御回路(2) 25の出力(2)（$Q_{r1}$(2)）が加算器26で合成され、その出力として無効電力基準値（$Q_{r1}$）が得られる。

【0008】次に本発明の作用について説明する。有効電力トランスジューサ19の出力$P_s$がバンドパスフィルター20に入力されると、その出力には電力系統固有の電力動揺周波数（およそ1Hz前後の値である）を含むある帯域の周波数成分$\Delta P_s$が検出される。電力系統に発生する電力動揺を抑制するには、発電機の回転速度$\omega$と同相の成分である発電機の制動トルク（電力）を増加するようにＳＭＥＳを制御すればよい。なお、発電機の回転子の位相角$\delta$と回転速度$\omega$の位相関係は90度ずれているので、$\Delta P_s$（$\Delta\delta$と同相である）を入力信号とする場

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合は90度位相を補償し、Δωが上昇（下降）したときはＳＭＥＳ設置点の母線の電圧を上げて（下げて）発電機の有効電力（→制動力）を増加するようにＳＭＥＳの無効電力を制御すればよいことになる。従って、位相補償回路21では上述したように位相を90度近く補償し、制御回路(1) 22では制動効果をどの程度にするかを調整する。

【０００９】一方、電圧トランスジューサ23の出力$V_s$がバンドパスフィルター24に入力されると、その出力には$P_s$の場合と同じように電力系統固有の電力動揺周波数を含むある帯域の周波数成分$\Delta V_s$が検出される。制御回路(2) 25では電圧変動の抑制効果をどの程度にするかを調整する。制御回路(1) 22の出力(1) （$Q_{ref}$ (1)）と制御回路(2) 25の出力(2) （$Q_{ref}$ (2)）は加算器26で合成され、その出力として無効電力基準値（$Q_{ref}$）が得られるが、上述したように、$Q_{ref}$ (1)の作用により電力動揺が抑制され、$Q_{ref}$ (2)の作用により電力動揺に伴なう過渡的な電圧変動が抑制される。

【００１０】

【発明の効果】以上説明したように、本発明によればＳＭＥＳの無効電力が基準値に一致するように制御する構

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成としたので、電力系統に発生する電力動揺の抑制並びに電力動揺に伴なう過渡的な電圧変動を抑制することが可能となり、ＳＭＥＳの特性を十分利用できる。

【図面の簡単な説明】

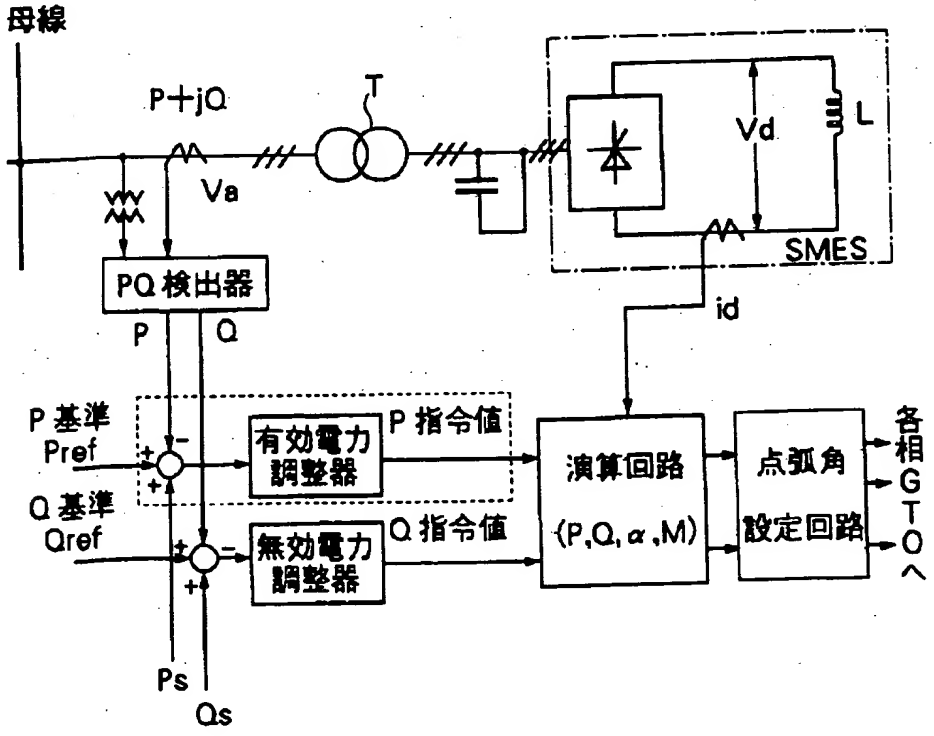
【図１】本発明によるＳＭＥＳの制御装置を説明するための一実施例の構成図。

【図２】ＳＭＥＳの有効・無効電力制御装置の全体の制御ブロックを挙げた参考図。

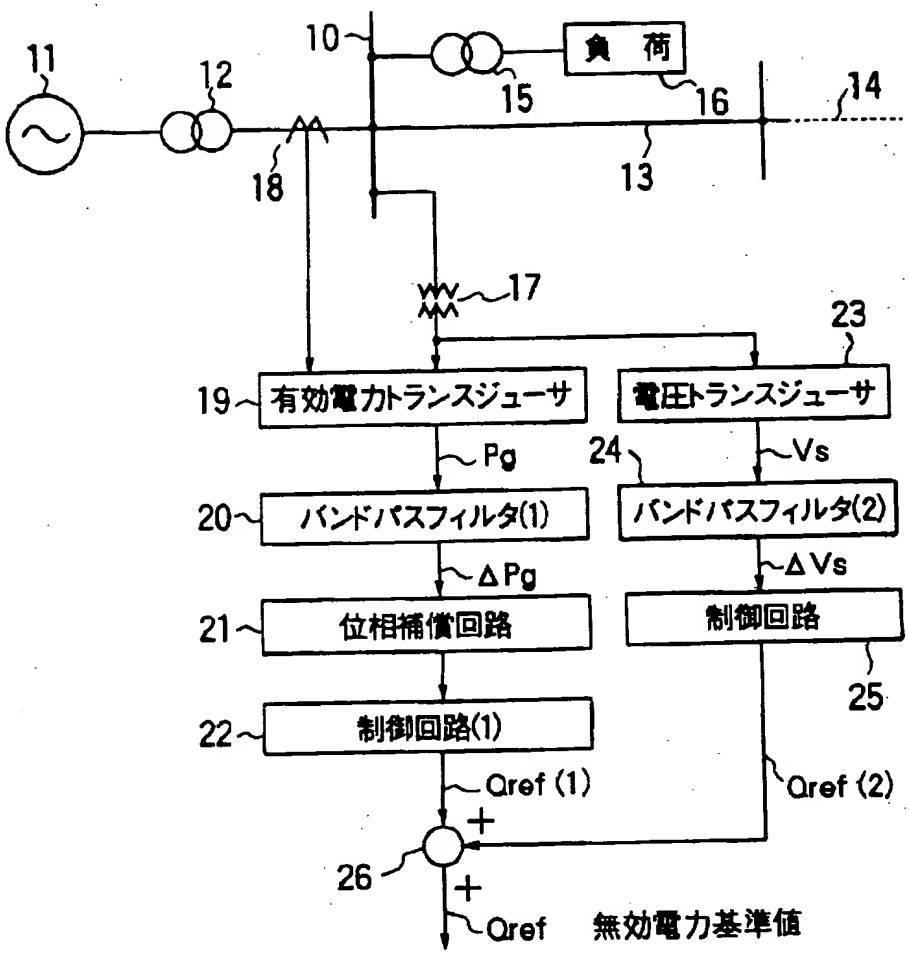
【符号の説明】

10　母線
11　発電機
17　電圧変成器
18　電流変成器
19　有効電力トランスジューサ
20　バンドパスフィルター(1)
21　位相補償回路
22　制御回路(1)
23　電圧トランスジューサ
24　バンドパスフィルター(2)
25　制御回路(2)
26　加算器

【図２】



【図1】


11
12
10
15
負荷
16
14
18
13
17
23
19
有効電力トランスジューサ
電圧トランスジューサ
Pg
24
Vs
20
バンドパスフィルタ(1)
バンドパスフィルタ(2)
ΔPg
ΔVs
21
位相補償回路
制御回路
25
22
制御回路(1)
Qref (1)
Qref (2)
+
26
+
Qref
無効電力基準値

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Date of request for examination: [1998/ 2/26]
Accelerated examination ( )
Public disclosure no/date: 1993- 30686 [1993/ 2/ 5]
Examined publication no/date (old law): [ ]
Registration no/date: 3228529 [2001/ 9/ 7]
Examined publication date (present law): [2001/11/12]
PCT application no:
PCT publication no/date: [ ]
Applicant: ELECTRIC POWER DEV CO LTD,TOSHIBA CORP
Inventor: OGIMOTO KAZUHIKO,KOMUKAI TOSHIHIKO
IPC: H02J 3/24 ,ZAA G05F 1/70 H02J 3/16
H02J 3/50 H02J 15/00 ,ZAA
FI: G05F 1/70 Z H02J 3/16 H02J 3/50 Z
H02J 15/00 ,ZAAB H02J 3/24 ,ZAAZ
F-Term: 5G066DA04,JA03,JB01,5H420BB15,BB16,CC05,DD04,EA04,FF06,FF07,FF19,FF24,
BB02
Expanded classicication: 431,433
Fixed keyword: R006
Citation: [ , . . , ] ( , , )
Title of invention: CONTROLLER FOR SUPERCONDUCTING ENERGY STORAGE DEVICE

Abstract: PURPOSE: To suppress power fluctuation and to suppress a transie nt voltage variation by utilizing characteristics of a superconducting energ y storage device (SMES). CONSTITUTION: Effective power of a generator 11 mou nted near a superconducting energy storage device (SMES) is input as an inpu t signal, and a first output $Q_{ref}$ 1 is obtained through a band pass filter 20, a compensator 21 and a control circuit 22. A voltage of a bus 10 mounted wi th the device is input as an input signal, and a second $Q_{ref}$ 2 is obtained thr ough a band pass filter 24 and a control circuit 25. The $Q_{ref}$ 1 and the $Q_{ref}$ 2 a re combined by an adder 26 as a reactive power reference value.COPYRIGHT: (C )1993,JPO&Japio

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)
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Original registration number: ( )
Retroactive date:[ ]
No. of claims ( 1)
Classification of examiners decision/date:
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) [2001/ 8/16]
Final examinational transaction/date:
(registration) [2001/ 9/ 7]
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(A621 1998/ 2/27,WRITTEN REQUEST FOR
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(A961 1998/ 3/27,CORRECTION DATA BY EX OFFICIO (FORMALITY), : )
(A131 2001/ 5/29,WRITTEN NOTICE OF REASON FOR REJECTION, : )
(A53 2001/ 7/24,WRITTEN OPINION, : )
(A523 2001/ 7/24,WRITTEN AMENDMENT, : )
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(A967 2001/ 7/30,RECOGNITION?ADDITION INFORMATION, : )
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)(A61 2001/ 8/27,PAYMENT OF ANNUAL FEE, : )
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Demandant: -
Defendand: -
Opponent: -
Classification of trial decision of opposition/date: ( ) [ ]
Final disposition of trial or appeal/date: ( ) [

]
Trial and opposition intermediate record:

Registration intermediate record:
(R01 2001/ 8/16,A NOTICE OF DECISION OF REGISTRATION, :01)
(R100 2001/ 8/27,A WRITTEN PAYMENT FOR ESTABLISHMENT, :01)
(R150 2001/ 9/18,A REGISTRATION CERTIFICATE, :01)
Amount of annuity payment: 3Years
Extinction of right/Lapse date of right: ( )[ ]
Proprietor: 13-ELECTRIC POWER DEV CO LTD
13-TOSHIBA CORP
Status of register: ( )

**Machine Translation**

57)
[WHAT IS CLAIMED IS]

[Claim 1]
Control arrangement of a superconduction energy storage device; wherein; The phase compensated circuit which adjusts control phase as an input signal with effective electricity to make a bandpass filter of the first to detect electricity unrest of electricity system peculiarity and braking torque of an above dynamo increase of a dynamo of the neighborhood where a superconduction energy storage device is installed in, A control circuit of the first to adjust a braking effect is gone through, and the first output is got, and a control circuit of the second to adjust a bandpass filter of the second to detect electricity unrest of electricity system peculiarity as an input signal with the voltage of the bus that said superconduction energy storage device is installed in and a restraint effect of a voltage change is gone through, and the second output is got, the output which each output of above *dai* 1, the second is synthesized in adder, and is provided is done with invalidity electricity reference value.

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[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[INDUSTRIAL APPLICATION FIELD]
The present invention relates to control arrangement of a superconduction energy storage device.
[0002]

[PRIOR ART]
When, a superconduction energy storage device (for illustration purposes, SuperconductingMagnetic Energy Storage is sketched with SMES as follows), originally surplus electricity in an electricity system, this is taken in, and it is saved as magnetic energy, when was lacked electricity, magnetic energy is converted into electricity, and it is ejected to an electricity system, is controlled so that demand and supply of electricity in an electricity system balance. However, SMES does not merely remain in an energy storage so that absorption / release of the effective electricity and invalid electricity comprises the ability that high speed can control by transducer unit , a load flattery function for fast load variation to occur to an electricity system, electricity unrest and contribution for system stabilization control such as restraint of a voltage change are that is to say expected in a contribution equal thing for frequency change control. Suggestion is already settled about a control unit of effective electricity of SMES directed to load flattery as opposed to fast load variation to occur to an electricity system (Japanese Patent Application No. 2-59108).
[0003]

[PROBLEM TO BE SOLVED BY THE INVENTION]
Effective electricity of SMES is controlled, and, according to the described above before device, load as opposed to fast load variation follows , in addition, it was constant, and the control of invalidity electricity of SMES held only the voltage of a system in the same way as

standstill type invalidity electricity compensation device (SVC). The present invention was done in view of the circumstances, it is for the purpose of providing a control unit of the device that possible superconduction energy stores restraint of electricity unrest and restraint of a transient voltage change by controlling invalid electricity of SMES.
[0004]

[MEANS TO SOLVE THE PROBLEM]
The present invention does effective electricity of a dynamo of a neighborhood of the SMES establishment point with an input signal to achieve the object, the first output provided through the first control circuit to adjust the phase compensated circuit which adjusts control phase to make braking torque of the first bandpass filter detecting electricity unrest of electricity system peculiarity and the dynamo increase and a braking effect and the voltage of a bus of around SMES establishment point are done with an input signal, the output signal which it made add the second output provided through the second control circuit to adjust the second bandpass filter which detected electricity unrest of electricity system peculiarity and a restraint effect of a voltage change each, and was provided was done with invalidity electricity reference value of availability / an invalidity power control device of SMES and constitution to do.
[operation]
If invalid electricity of SMES is controlled by the null and void electricity reference value to agree, the first output composing null and void electricity reference value acts on to contribute to restraint of electricity unrest, one, the second output act on to contribute to restraint of a transient voltage change.
[0005]

[EXAMPLE]
An example is explained when taken with the drawing as follows. FIG. 1 is a figure of constitution of one embodiment to explain control arrangement of SMES with the present invention, and FIG. 1 shows a making circuit of invalidity electricity reference value in availability / an invalidity power control device of SMES in particular. In addition, FIG. 2 nominates a figure of total control block of an effective invalid power control device of SMES for reference. And a dotted line part of FIG. 2 was existing application contents, and it was shown daringly to distinguish from a thing of the present invention. FIG. 2 is easily explained. At first, SMES goes through transformer T, and it is connected to a bus. Null and void electricity Q is detected by means of a PQ detector from a bus neighborhood, is run to agree in order value $Q_s$ (normal driving time $Q_{ref}$, zero), alpha (a phase control corner) with an operationed circuit, M (control rate) are operated, is output to each aspect GTO. FIG. 2 is in subject matter of the present invention, and ache, and explanation more than this is not done.
[0006]
Next, FIG. 1 is explained. In FIG. 1, SMES which is not illustrated in a bus is connected to 10. Transmission line 13 intervenes between main transformer 12 and 11 with a dynamo of a neighborhood of the SMES establishment point, and it is connected to electricity system 14. As for 15, as for transformer for load, 16, as for load, 17, as for voltage transformer detecting the voltage of bus 10, 18, as for current transformer detecting an electric current to flow into bus 10 from dynamo 11, 19, availability electricity $P_g$ of dynamo 11 is provided in the output (direct current value) in electricity transducer effectively. A bandpass filter (1) that 20 takes out ingredient ? $P_g$ of a certain frequency band in electricity $P_g$ effectively 21 and 22, each, a phase compensated circuit and a control circuit (1) It attends, and there is.

[0007]
On the other hand, As for 23, voltage $V_s$ of bus 10 is provided in the output (direct current value) in voltage transducer. A bandpass filter (2) that 24 takes out ingredient ? $V_s$ of a certain frequency band in voltage $V_s$ 25, a control circuit (2) It attends, and there is. A control circuit (1) 22 output (1) ($Q_{ref}$ (1)) ) and a control circuit (2) 25 output (2) ($Q_{ref}$ (2)) ) is synthesized with adder 26, null and void electricity reference value ($Q_{ref}$) is provided as the output.
[0008]
Next, Operation of the present invention is explained. When output $P_g$ of electricity transducer 19 is input into bandpass filter 20 effectively, frequency components ? $P_g$ of the band which there is which includes electricity unrest frequency (it is about around 1Hz value) peculiar to an electricity system in the output is detected. SMES should be controlled to control electricity unrest to occur to an electricity system to increase with braking torque (electricity) of the dynamo which is an ingredient of rotational velocity omega and in-phase of a dynamo. In addition, Because a phase relationship of phase angle delta and rotational velocity omega of a rotor of a dynamo is out of 90 degrees, when ? $P_g$ (it is ? delta and in-phase) is done with an input signal, around 90 degrees aspect is compensated for, when ? omega did a rise (a drop), the voltage of a bus of the SMES establishment point is given (and it is lowered) and, of a dynamo, it is to control invalidity electricity of SMES to increase in electricity (? braking) effectively. Thus, 90 degrees are near, and phase is compensated for as had stated above with phase compensated circuit 21, a control circuit (1) It adjusts how much a braking effect is made with 22.
[0009]
On the other hand, When output $V_s$ of voltage transducer 23 is input into bandpass filter 24, frequency components ? $V_g$ of the band which there is which includes electricity unrest frequency peculiar to an electricity system for the case $P_g$ in the same way in the output is detected. A control circuit (2) It adjusts how much a restraint effect of a voltage change is made with 25. A control circuit (1) 22 output (1) ($Q_{ref}$ (1)) ) and a control circuit (2) 25 output (2) ($Q_{ref}$ (2)) ) is synthesized with adder 26, null and void electricity reference value ($Q_{ref}$) is provided as the output, but , as mentioned earlier, electricity unrest is controlled by operation of $Q_{ref}$ (1), a transient voltage change with electricity unrest is controlled by operation of $Q_{ref}$ (2).
[0010]

[EFFECT OF THE INVENTION]
As discussed above, According to the current invention, because it was done with constitution to control so that invalid electricity accorded in reference value of SMES, a restraint equal thing of electricity unrest to occur to an electricity system gets possible to control a transient voltage change with electricity unrest, a characteristic of SMES can be used enough.

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[BRIEF DESCRIPTION OF DRAWINGS]

[FIG. 1]
It is a figure of constitution of one embodiment to explain control arrangement of SMES with the present invention.
[FIG. 2]
It is the reference drawing which total control block was nominated for of an effective invalid

power control device of SMES.

[DENOTATION OF REFERENCE NUMERALS]

10 Bus 11 Dynamo 17 Voltage transformer 18 Current transformer 19 Effective electricity transducer 20 Bandpass filter (1) 21 Phase compensated circuit 22 Control circuit (1) 23 Voltage transducer 24 Bandpass filter (2) 25 Control circuit (2) 26 Adder